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Process Automation: Beware the Reality Gap (Again*)

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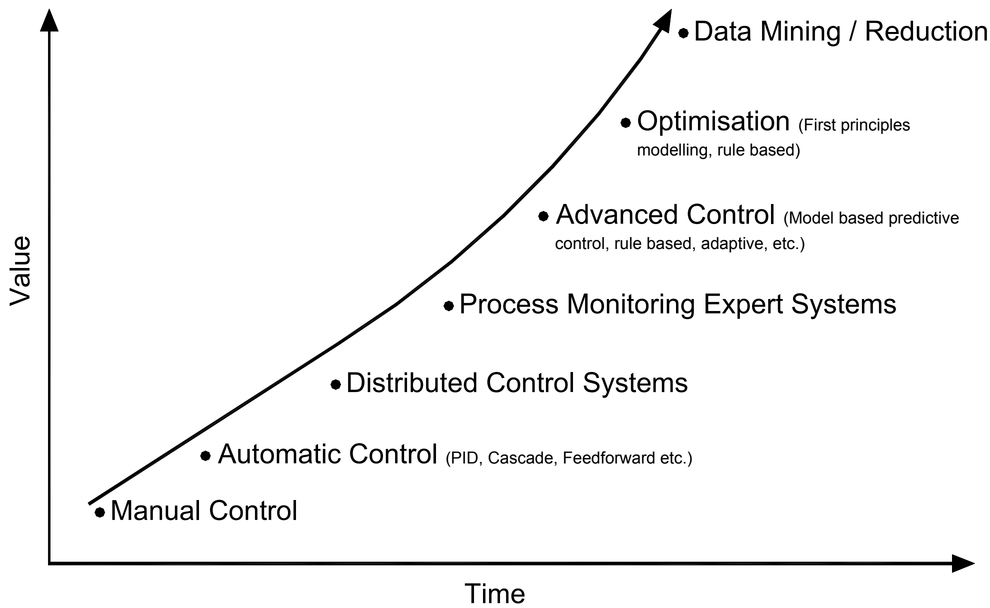
*Oblique reference to the previous article 'Safety Management; Beware the Reality Gap', published in Volume 13, issue 6 of Engineering Management, December/January 2003/2004.

I saw a presentation recently in which advancing process optimisation technologies were represented essentially as shown in Fig 1. Now I understand that this was never intended as a rigorous representation of some immutable law. The figure is intended rather to relay a notional progression and is 'for illustrative purposes only'. The presenter did explain that the time-line was essentially associated with stages of maturation of a company rather than 'real time'. Fair enough. Whatever the qualifications, it seems clear that the figure and similar diagrams are intended to point to the sunlit high ground of advanced automation technology. The representation does however incorporate some subtle, perhaps inadvertent, but nonetheless significant distortions.



The curve shown is based on one possible trajectory through 'Automation Technology Space'; the technologies are not necessarily invoked in the order shown, and some further categories or sub categories might be usefully introduced to significantly improve the 'resolution'. Notice how the curve turns upwards; value is accelerating onwards and upwards into an ever brighter future.

I suggest that this is at odds with a fundamental law we all have experience of - that of diminishing returns. The values to be derived from the different technologies are not independent and simply additive. If the notionally lower levels are not implemented effectively, the higher levels are likely to be seriously compromised. It is conceivable the curve would actually reverse as increasingly burdensome technologies fail to deliver more value than their costs.

Although the wisdom of first picking off the ‘low lying fruit’ or the ‘fat rabbits’, is self evident, it is surprising how often this is overlooked in the zeal with which more elusive, but more seductive targets are pursued.

Now, I do not mean to say that the higher level technologies are without value, but they should be applied in the appropriate context, once the lower technologies have been essentially exhausted.

Whatever their intrinsic technical merits, their utility and their value is likely to be conditioned by the relatively mundane (and often therefore overlooked) considerations such as ongoing support requirements, operator friendliness, robustness and comprehensibility. I confess I maintain what I regard as a healthy scepticism towards any offering that requires anything beyond sixth form maths to be understood.

Some of the benefits claimed for higher technology approaches to optimisation may be much more simply realised by advanced applications of conventional regulatory controls. Statistical techniques employed in data mining or data reduction may reveal previously unrecognised correlations between plant variables and plant performance, but straightforward consideration of the physical, chemical and thermodynamic nature of the process and the associated mass and energy balances will identify the dominant relationships. If you have not done this first, the higher level technologies are likely to ‘reveal’ what is blindingly obvious to the prepared mind!

Consider also that many of the advanced technologies will operate through the basic regulatory control provision (e.g. flow controllers). If this is not properly implemented because, for example, the measurements are flawed, or the valve has the wrong characteristic, is oversized or suffers from hysterisis, or the controller is mistuned, the performance of the advanced control will inevitably be compromised.

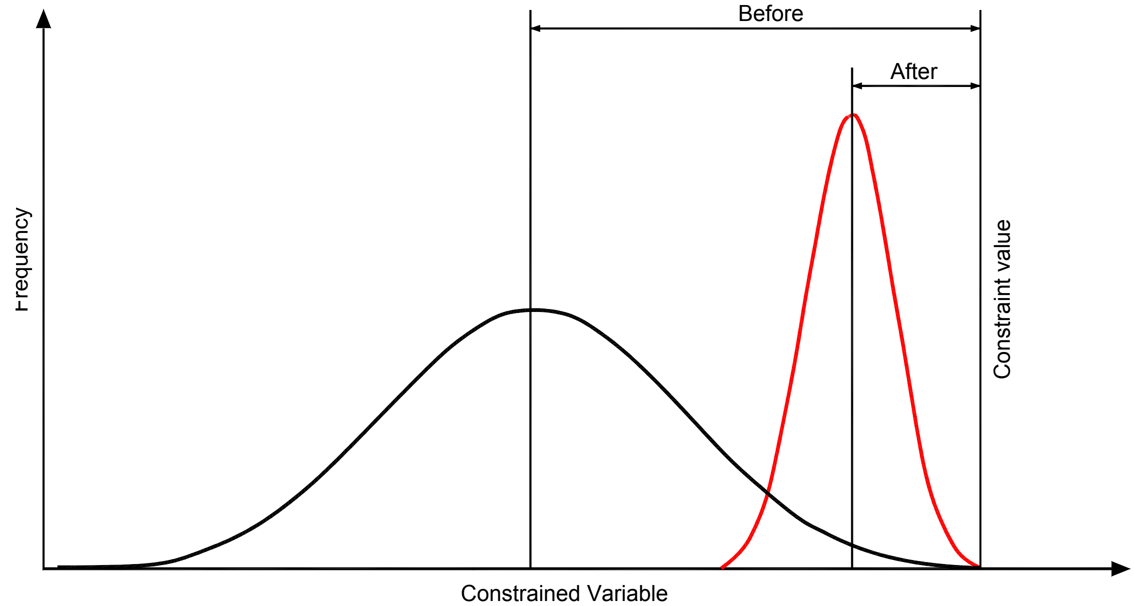
Some approaches aspire to universal applicability, in order to reduce the need for bespoke design effort. This may bring the benefits of higher technology to organisations that might not otherwise have the wherewithal to procure and implement improved automation. Again, however, I must confess something of a prejudice here; it strikes me as wrong headed to seek to improve without understanding. I do not say this cannot work, but there are dangers; simpler, more cost effective measures might well be available and remain overlooked. Although discernible improvement might arise from the application of a ‘universal black box’ solution, the improvement might well be less than would have been realised if the lower technology had been more effectively implemented. This ‘lost’ improvement opportunity may remain masked by the higher technology.

It seems some practitioners are disdainful of the ‘humble’ three term (PID) controller, but it has the distinct virtues of being relatively simple, friendly and robust. It is not without good reason that it has been the automation mainstay throughout the last century. This technology should be regarded as ‘mature’ rather than ‘old fashioned’. Note that even with such mature technology there are unexploited opportunities: derivative action was invented in 1912, but you will find that it is ‘set to zero’ by default in many applications where it might be useful because it is not properly understood or because it adds another dimension to the loop tuning problem.

The everyday reality in many process operations revolves around availability and the need to avoid disruption to production. This is understandable; production disruption is highly visible and aggravating. The question “Is the plant ON or OFF?” is simple to answer, simple to understand. “Is the plant running optimally?” is tougher. Once you start to enquire you may be surprised at what your operations learn to live with. A variety of short cuts, compromises and deviations from standard operating practice and design intent may well be discovered.

A simple check when you next go through the control room: Look for controllers that are switched to manual. Ask why? Ask the operators which loops give them trouble? This might prove quite revealing. If the loops are not continually in auto and the plant is not continuously stable, there are more fundamental issues to be addressed. Remember though that the operators instinct may well be to operate the plant for minimum aggravation NOT maximum profit. A plant may be perfectly stable and operating sub-optimally. For maximum profit you are likely to have to ‘sail closer to the wind’, and operate closer to plant constraints.

Many processes have well defined, easily identifiable, optimum operating points: it is often simply a case of operating as close as possible to a constraint (trip point or product specification limit) without violating that constraint. The conventional regulatory control provision may be engineered to reflect this. Basically this revolves around reducing variability in the process and placing the control point closer to the constraint. See the distribution plot in Fig 2.



Many control and instrumentation engineers and technicians may be left with uneasy feelings of inadequacy when faced with the apparent ‘sea’ of impenetrable papers on advanced control. Am I being left behind? How am I to cope? They may rest easy. For most of this stuff the chances of it being relevant to prevailing circumstances in most process industries are as close to zero as makes no difference. The authors may well have impressive expertise in their own esoteric fields, but most would not recognise a sticking control valve if it bit them on the behind (as they have a metaphorical tendency to do). Their work may add to the future automation toolbox, but the typical C&I design/operations/maintenance engineer needs to focus on the here and now.

Business managers may be concerned that they are failing to exploit high technology automation opportunities, or they may be agonising over whether they should approve expenditure on such technology. My message is that you should not even consider these questions until you are satisfied that the low tech is implemented effectively. It has to be said that control professionals may be seduced by the intriguing sophistication of advanced technology. It is worth a sanity check to establish whether their enthusiasm makes good business sense.

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Erratum: Derivative action was introduced in 1935, not 1912.